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Teaching reading strategies in history lessons: A micro-level analysis of professional development training and its practical challenges

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Highlights

- PD interventions in educational settings face practical implementation challenges
- PD training in reading strategy instruction leads to a higher instructional variety
- PD training in data use does not automatically lead to actual extensive data use
- Assessment of PD training feasibility requires small-scale, explorative research
- Micro-level analysis of teachers' experiences is essential in educational research

Abstract

Reading comprehension is an important skill in secondary education, yet many history teachers find it difficult to provide adequate reading strategy instruction. In this study, we designed a digital learning environment to support teachers' instruction of reading strategies based on student data. We provided history teachers in the experimental conditions with a visualisation of student performance data. Additionally, these teachers received professional development (PD) training and a guiding manual on how to translate these data into structured, explicit reading strategy instruction. Teachers in the control condition were only provided with basic data. We investigated teachers' personal experiences through micro-level analysis of qualitative interview data. Our results show that teachers in the experimental condition improved the variation of their strategy instruction and used modelling behaviour more often after the PD training. However, we also identified multiple contextual implementation barriers that provided us with important suggestions for future practice-oriented educational research.

Keywords: teacher professional development; educational data use; strategy instruction; reading comprehension; program evaluation

Teaching reading strategies in history lessons: A micro-level analysis of professional development training and its practical challenges

1. Introduction

Comprehending expository texts is an essential skill for students in secondary education, especially for the subject of history. While reading their history textbooks, students are required to infer difficult word meanings, identify main ideas, explain causal relationships, or question the author's assumptions. Therefore, it is essential for a student to know how and when to apply generic and subject-specific reading strategies (Hall, 2005; Heller & Greenleaf, 2007; Nokes, Dole, & Hacker, 2007; Shanahan & Shanahan, 2008). Reading strategies are deliberate actions that a student can attempt "to control and modify the reader's efforts to decode text, understand words, and construct meanings of texts" (Afflerbach, Pearson, & Paris, 2008, p. 368). Research has shown that explicitly teaching students to use strategies while reading can improve students' comprehension of text, which has led to an increased focus on literacy instruction in content areas (e.g., science or social studies) in the last two decades. Providing reading strategy instruction is no longer exclusive to language art class, but attainable in subjects like math, science, or history; reading strategies can be taught and applied across subjects (Hall, 2005; National Reading Panel, 2000).

Although the importance of integrating reading strategies in the history curriculum is widely acknowledged, observational studies in secondary education have shown that teachers do not always fully or correctly instruct them during their lessons. When observing lessons in Dutch secondary education, Linthorst and De Glopper (2015) calculated that 11.9% of the average lesson time was spent on reading instruction. When providing reading instruction, social studies teachers, including history teachers, mostly focused on vocabulary instruction and monitoring of students' comprehension. A similar study by Ness (2016), in which 600 minutes of lessons in middle school social studies classrooms were observed, showed that

10% of the overall lesson time was dedicated to reading strategy instruction, focusing on text structure, question answering, and summarisation. Finally, research suggests that content area teachers often do not feel responsible or qualified to provide reading strategy instruction, indicating a need for professional training in this area (Greenleaf, Schoenbach, Cziko, & Mueller, 2001; Hall, 2005; Ness, 2016).

1.1. Teaching Reading Strategies

Research has shown that the instruction of comprehension-fostering reading strategies in secondary school classrooms can elicit positive effects on students' academic performance (de Jager, Reezigt, & Creemers, 2002; Fisher & Frey, 2008; Palincsar & Brown, 1984; National Reading Panel, 2000). Teaching reading strategies is especially effective for adolescent students of 12–13 years old; in the Dutch educational system, this is around the time when they experience the transition from primary to secondary education. A meta-analysis on reading strategy interventions in whole classrooms showed the largest effect sizes for intervention studies conducted with researcher-developed tests in grades 6–8, compared to other grades (Okkinga, van Steensel, van Gelderen, van Schooten, et al., 2018).

Unfortunately, there seems to be a decrease in content area teachers' actual literacy instruction around eighth grade, such as encouraging self-questioning, summarizing, or monitoring comprehension (Guthrie & Davis, 2003). Research has shown that content area teachers encounter difficulties when incorporating literacy strategies in their lessons (Hall, 2005; O'Brien, Stewart, & Moje, 1995). Teachers and textbook methods focus mostly on asking questions about the content of the text (i.e., cognitive knowledge) and provide little explicit strategy instruction on how students can monitor or improve their reading comprehension (i.e., metacognitive knowledge; de Jager et al., 2002; Fisher & Frey, 2008). Moreover, disciplinary literacy instruction—instruction of reading strategies with a subject-

specific approach, which is often regarded as even more effective—rarely occurs in content area classrooms (Moje, 2008).

1.1.1. Effective reading strategies. Students can apply several reading strategies before, during, and after reading to increase their comprehension of text. A meta-analysis by Donker, Kostons, Dignath-van Ewijk, and Van der Werf (2014) on effective learning strategies showed that a combination of cognitive and metacognitive strategies, such as orienting, planning, structuring, reflecting, and evaluating, led to positive results on measures of reading comprehension. More specifically, the practices of activating prior knowledge, defining difficult words, identifying main ideas, summarising, and reflecting on the contents of the text are all helpful strategies to support students' text comprehension (Afflerbach et al., 2008; Okkinga, van Steensel, van Gelderen, van Schooten, et al., 2018; Palincsar & Brown, 1984). Other strategies linked to text comprehension are expectation strategies (e.g., predicting the subject of the text), adjustment strategies (e.g., adapting reading behaviour according to one's comprehension of the text), and motivating strategies (e.g., focusing on the usefulness or pleasure of reading a text).

1.1.2. Instructional methods. There are multiple strategies to instruct, and multiple methods to instruct strategy use. For example, a teacher can explain strategies in front of the classroom by providing verbal information. Furthermore, a teacher can also engage the students during the instruction by asking them questions about the instructional material. A possible way to further classify instructional modes is to make a distinction between implicit and explicit instruction, as done by Ellis (2009) and Dignath-van Ewijk, Dickhäuser, and Büttner (2013). It is important to note here that the distinction between implicit and explicit instruction is not straightforward, and that the terms have been operationalised in different ways in educational research (Ellis, 2009). A detailed description of the debate around

implicit and explicit instruction is beyond the scope of this paper. We will follow the interpretation of Ellis (2009) and Dignath-van Ewijk et al. (2013).

First, teachers can implicitly provide instruction on reading strategies. According to Ellis (2009), in language education "implicit instruction is directed at enabling learners to infer rules without awareness" (p. 16). Thus, a teacher directs students to the application of a rule or strategy without explicitly focusing the attention on the strategy itself. Second, teachers can provide instruction in an explicit way. During explicit instruction, in contrast to implicit strategy instruction, the teacher elaborates on the application or the benefit of a certain strategy, or encourages students to reflect on it.

Another mode to provide instruction to students is known as modelling behaviour. Modelling refers to the explicit application of a strategy by using a first-person view (e.g., *"Before I start reading this text, I am going to think of what I already know about this subject"*). Modelling behaviour, or providing instruction while thinking aloud, is viewed as an effective way to foster students' strategic ability (Dignath-van Ewijk et al., 2013; Okkinga, van Steensel, van Gelderen, van Schooten, et al., 2018). However, modelling strategy use is difficult for most teachers in secondary education, because they often lack background knowledge about the use of reading strategies (Okkinga, van Steensel, van Gelderen, & Sleegers, 2018).

1.1.3. Teachers' attitudes towards reading strategy instruction. The ways in which teachers think about and teach reading strategies influences their instructional behaviour (Hall, 2005). Following constructivist theories, a teacher does not only transmit information and knowledge, but also has to facilitate and coach the students' learning process (de Jager, Reezigt, & Creemers, 2002). Intervention effects in the field of reading comprehension are dependent on teacher knowledge, behaviour, and instructional quality (Okkinga, van Steensel, van Gelderen, & Sleegers, 2018), and there is strong variation between teachers (Staman,

Visscher, & Luyten, 2014). A micro-level study by Seymour and Osana (2003), in which they evaluated four training sessions on the implementation of reading strategy instruction with two middle-level teachers, showed that the teachers did not fully understand the definition of specific strategies and, therefore, faced problems during the implementation. Furthermore, teacher efficacy (i.e., teachers' feelings of competence towards instruction) also influences teachers' instructional behaviour, and is shown to relate positively to students' reading comprehension performance (Chambers Cantrell, Almasi, Carter, & Rintamaa, 2013).

With regard to instructional behaviour, previous research has shown that teachers' skills expand over time; for example, a teacher first needs sufficient classroom management skills to be able to provide reading strategy instruction (van de Grift, 2014). The instruction of strategies, including reading strategies, does not occur frequently during classroom observations in secondary education, since it is considered a complex and difficult form of instructional behaviour that requires many years of teaching experience (van de Grift, 2014; van der Scheer, Glas, & Visscher, 2017). Another explanation for the fact that strategy instruction does not occur often is because teachers' knowledge about reading strategies is inadequate (Seymour & Osana, 2003), or because a teacher does not feel skilled to do so or responsible for providing this type of instruction (Hall, 2005; Ness, 2016).

1.2. Using Student Data for Instructional Practices

Educational technology provides an opportunity to support teachers' instructional behaviour. In recent years, digital data have transformed instructional practices in secondary education (Hutchison & Colwell, 2014). Teachers nowadays can draw from a large source of data, such as formative assessment results in student monitoring systems, to prepare their lessons and to meet their students' instructional needs. The process of using student data to inform instructional practice is also known as Data-Based Decision Making (DBDM; Schildkamp, Lai, & Earl, 2013), and its use has been associated with increased student

performance (Campbell & Levin, 2009). However, only providing teachers with data is not enough. Mandinach and Gummer (2016) argue that teachers need to be data literate, which means that they are able "to transform information into actionable instructional knowledge and practices by collecting, analysing, and interpreting all types of data … to help determine instructional steps" (p. 367).

DBDM can occur at the school, classroom, and student level. For example, a teacher can collect formative assessment data at a classroom level to inform and adapt his or her instructional behaviour (Hoogland et al., 2016; Schildkamp et al., 2013). In their review of effective differentiation practices, Deunk, Smale-Jacobse, De Boer, Doolaard, and Bosker (2018) found that teachers using computerized systems as a differentiation tool had small to medium positive effects on students' performance in primary education (d = 0.29). Similarly, a study in secondary education in New Zealand showed that a DBDM intervention, in which teachers collaboratively practiced profiling based on student assessment data, had positive effects on students' reading comprehension performance (Lai, Wilson, McNaughton, & Hsiao, 2014). This indicates that students benefit when teachers apply educational technology and assessment data to facilitate differentiated instruction, for example by adapting their instruction to meet the needs of low, average, and high-performing students.

Educational technology is also capable of providing teachers with visualisations of formative assessment log data, allowing them to see at a glance how their students perform and which students face difficulties with certain skills or assignments. However, this data is often very extensive and only easily interpretable for skilled, well-informed teachers (Vanhoof, Verhaeghe, Van Petegem, & Valcke, 2013), and therefore not common practice in secondary education. A Dutch study by Kippers, Wolterinck, Schildkamp, Poortman, and Visscher (2018) showed that secondary teachers mostly use pen-and-paper tests instead of digital assignments, limiting the possibilities for using advanced analyses of results for

subsequent teaching. In addition, questionnaire and interview data showed that teachers only made use of data for instructional purposes in 25–50% of the lessons. This made Kippers et al. (2018) emphasise the need for professional development for teachers in DBDM.

1.3. Professional Development Training

Although the use of computerized systems with student data is known to have positive effects on students' performance, this is likely to be influenced by the professional development (PD) practices accompanying the implementation of these systems (Deunk et al., 2018). Providing teachers with student data is only helpful when teachers know how to effectively interpret and use these data for their instructional practice. Although there seems to be scientific consensus about what effective instruction based on student data entails, the use of data to guide instructional practices receives little attention in pre-service teachers' education (Mandinach & Gummer, 2013). Similarly, recent studies have shown that in-service teachers experience challenges in using data (Hoogland et al., 2016; Mandinach & Jimerson, 2016; Staman et al., 2014; Vanhoof et al., 2013). Therefore, professional training in using student data for instructional purposes is also an important prerequisite for effective instruction in digital learning environments.

The need for continuous learning with regard to data use in education is widely acknowledged (Mandinach & Jimerson, 2016; Poortman, Schildkamp, & Lai, 2016). It is insufficient to only help teachers develop the necessary skills to analyse data, as is the case in most PD programmes (Marsh, 2012). Rather, teachers need to be able to integrate data skills with subject matter content knowledge and pedagogical content knowledge (Staman et al., 2014); yet, many existing PD programmes lack such a triangulation (Mandinach & Gummer, 2016).

The implementation of new teacher behaviour is strongly promoted when the PD intervention includes the provision of concrete content materials for teachers. In the context of

reading comprehension, for example, it is essential to incorporate content knowledge about effective generic and subject-specific reading strategies (de Jager et al., 2002; Lai et al., 2014). PD training focusing on content knowledge and pedagogical content knowledge in the field of reading strategy instruction has shown promising results. With regard to content knowledge (i.e., knowledge about reading strategies), studies in the review by Hall (2005) showed that providing teachers with courses in content area reading can help teachers understand the benefits of teaching reading strategies, as well as create a positive attitude towards reading. With regard to pedagogical content knowledge (i.e., knowledge about instructional methods), De Jager et al. (2002) showed that training teachers to apply two models of instruction, more specifically the cognitive apprenticeship model and the direct instruction model, led to successful changes in teachers' instructional behaviour. Furthermore, a study by Fisher, Frey, and Lapp (2011) showed that teachers who were trained and coached to use think-aloud strategies in the classroom improved their instructional behaviour, and that as a result, their students improved their performance on a standardised reading assessment.

1.3.1. Studying the effectiveness of PD interventions. Based on scientific consensus about the critical characteristics of professional development, Desimone (2009) proposed a core conceptual framework for studying the effects of PD on teachers and students which "allows for testing the theory of teacher change (e.g., that professional development alters teacher knowledge, beliefs, or practice)" (p. 185). According to this framework, a PD intervention is expected to influence teachers' knowledge and skills and change teachers' attitudes and beliefs, which in turn leads to changes in instruction (see Figure 1). Subsequently, the changes in instruction are expected to lead to improved student performance.

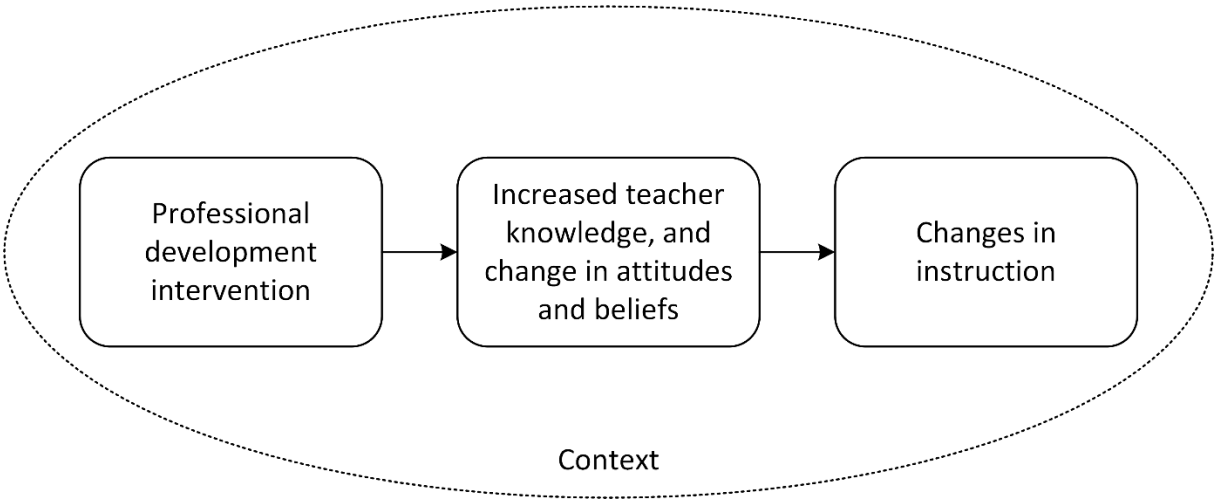

Figure 1. Conceptual framework for studying the effects of professional development on teachers (based on the framework by Desimone, 2009).

An essential component in Desimone's (2009) PD framework is the context in which the PD intervention occurs. The context is an important mediator and moderator in PD interventions; for example, interventions are influenced by teacher and student characteristics, and context factors at the school or classroom level. To provide a comprehensive account of effective components within PD intervention studies it is important to include the critical role of context factors.

Additionally, Desimone (2009) discusses appropriate strategies for measuring the effects of PD on changing teacher practice. She argues that mixed-method studies using interviews and classroom observations are "appropriate for providing narratives, examples, and anecdotes to answer research questions … describing and understanding the complexities of professional development in a specific context, how beliefs and attitudes change, and the processes through which teachers change their instruction" (p. 190). Additionally, surveys can obtain valid and reliable data on teachers' instructional practice, knowledge, and beliefs. However, the field of PD in education is still developing, and we need more extensive micro-level research to determine best practices.

1.3.2. Challenges of PD interventions. Although PD interventions in disciplinary literacy instruction or data use in education seem promising, there are many studies reporting practical limitations and implementation challenges. Hoogland et al. (2016) highlight contextual factors such as the presence of a DBDM school culture, facilitation by means of time and resources, and PD as important prerequisites for successful data use in education. Staman, Timmermans, and Visscher (2017) found that teachers face difficulties when enacting data-based PD interventions designed by researchers. For most teachers, it is challenging to translate student data into differentiated instruction; they need professional training, clear goals, and professional guidance such as feedback on their teaching practice. According to O'Brien et al. (1995), the secondary school system with its content area divisions prevents both teachers and students from acknowledging the importance of disciplinary literacy as an essential part of the course itself. The authors argue that practical interventions should integrate literacy instruction in the regular curriculum in order to be effective. Lastly, Van Kuijk, Deunk, Bosker, and Ritzema (2016) found that behaviour of teachers participating in scientific research studies is probably influenced by the knowledge that their instruction is being studied, a phenomenon known as the Hawthorne effect. Therefore, it is challenging for researchers to determine whether effectiveness of PD interventions stems from the contents of the intervention itself.

1.4. Size and Scope of the Current Study

To our knowledge, there are currently no studies combining PD training in reading strategy instruction and the use of digitally visualised student performance data. The present study explores at a micro-level the effects of a PD training in providing reading strategy instruction enhanced by visualised student data. Interventions in the field of data use in education range from broad, comprehensive reform initiatives to narrowly focused interventions, such as local training programmes and workshops (Mandinach & Gummer,

2016; Marsh, 2012; Schildkamp et al., 2013; van der Scheer et al., 2017). Although PD in data use received a lot of attention from policy makers and researchers over the past two decades, most studies in this field only yield small effects. Therefore, Hill, Beisiegel, and Jacob (2013) advocate the use of rigorous research and explorative (i.e., single-site) analyses at the early stages of PD. The starting point of this type of research, or 'Stage 1', is a one-site pilot study in which the feasibility of the PD programme is analysed in practice using only a small sample of teachers (Hill et al., 2013), using rich, qualitative data. With regard to the length of the intervention, the authors suggest four to six sessions, which "could be undertaken within a single academic year" (pp. 479–480).

In the current study, multiple history teachers from four different secondary schools implemented the use of a digital learning environment (DLE) called 'Gazelle'[1] in which students read multiple expository history texts and answered multiple-choice questions about these texts (ter Beek, Spijkerboer, Brummer, & Opdenakker, 2018). Based on log file data from this DLE, we provided teachers with visualised student performance data and a single PD training session focused on the subject of strategic reading of history texts, followed by six accompanying lesson formats in a guiding manual.

The framework proposed by Hill et al. (2013) fits well within the current educational environment in the Netherlands. Dutch teachers in secondary education suffer from high levels of workload and stress, which often lead to burnouts or even attrition among teachers (Harmsen, Helms-Lorenz, Maulana, & van Veen, 2018). Many existing PD programmes cover longer periods from several weeks to an entire school year, requiring major time investments and efficient resource management from teachers and school management (Marsh, 2012; Okkinga, van Steensel, van Gelderen, van Schooten, et al., 2018; van der Scheer et al., 2017; van Kuijk et al., 2016). To test the feasibility of the present study design

[1] Gazelle is a Dutch acronym for 'Gemotiveerd en Actief Zelfstandig Lezen', which roughly translates into 'Motivated and Active Independent Reading'.

and to identify contextual factors that promote or impede the implementation of the PD intervention, we qualitatively explored teachers' personal experiences. By adopting a micro-level analysis design, this study can offer a unique insight in the combination of reading strategy instruction and data use in secondary history education.

1.5. Research Aims

This study explores to what extent the provision of visualised student data, combined with a professional development training in providing strategy instruction enhanced by analysing and using these data, affects history teachers' instructional practices in the context of reading strategy instruction. Additionally, it offers a valuable insight in how teachers experience this type of research and which difficulties they encounter. Inspired by Desimone's core PD framework (2009) and the guidelines of Hill et al. (2013) for studying PD, we focus on (a) how a small but focused PD training affects teachers' knowledge, attitudes, and beliefs with regard to teaching reading strategies, (b) how it affects the instructional methods teachers utilise, and (c) how teachers experience the use of a DLE with visualised data and a PD training. We will address the following research questions:

1. In what ways does a PD training in reading strategy instruction and data use affect teachers' knowledge, attitudes, and beliefs with regard to teaching reading strategies?
2. In what ways does a PD training in reading strategy instruction and data use affect teachers' instructional methods?
3. How do teachers experience the use of the provided DLE with visualised student data and the PD training in reading strategy instruction and data use, and which contextual factors promote or impede a successful implementation?

2. Method

2.1. Participants

In the school year of 2017–2018, nine history teachers from four Dutch secondary schools participated in a yearlong intervention study (cf. ter Beek et al., 2018). All teachers had a minimum of ten years' teaching experience. This was favourable because research has shown that novice teachers often still need to develop their basic teaching skills before they are able to master more complex skills, such as providing strategy instruction (van de Grift, 2014; van der Scheer et al., 2017). The teachers' mean age was 45.3 years (*SD* = 9.84) and on average they had 15.1 years' teaching experience (*SD* = 6.85; range 10–32; see Table 1). One of the history teachers was female (11.1%). All teachers taught history to seventh-grade students (M_{age} = 12.5 years, *SD* = 0.45), divided over 13 classrooms. From now on, we will refer to individual teachers using the pseudonyms mentioned in Table 1.

Table 1

Characteristics of Participating History Teachers and Their Classrooms (cf. ter Beek et al., 2018)

Teacher[a]	Gender	Age	Educational qualification	Years' work experience	Condition	Number of classrooms	Educational track	Class sizes
Alex	Male	38	Masters	14	Experimental A	2	Pre-university	26, 27
Barbara	Female	49	Masters	16	Experimental A	3	Pre-university	25, 26, 27
Chris	Male	59	Masters	32	Experimental A	2	Prevocational	28, 26
David	Male	61	Bachelors	12	Experimental A	1	Prevocational	21
Eric	Male	39	Masters	10	Experimental B	2	Pre-university	24, 29
Frank	Male	35	Masters	11	Experimental B	1	Pre-university	29
George	Male	50	Masters	12	Control	1[b]	Pre-university	20
Ian	Male	36	Bachelors	11	Control			
Harry	Male	41	Bachelors	18	Control	1	Pre-university	22

Note. [a] All teacher names are pseudonyms. [b] George and Ian taught lessons to the same classroom; George during Phase 1, and Ian during Phase 2.

2.1.1. Teacher alteration. Due to workload issues, one classroom was divided over two teachers during the intervention. George taught this classroom during the first half of the school year, and Ian taught in the second half of the school year. Both teachers had comparable work experience (see Table 1).

2.2. Design and Context

We conducted an explorative mixed-method study with a quasi-experimental pretest-posttest design in an ecologically valid context. The study explores the effects of providing visualised data and a PD training on teachers' knowledge, attitudes, beliefs, and behaviour with regard to strategy instruction on a micro-level. Although the study has been conducted at multiple schools, its explorative nature suits the 'Stage 1' type of research in the proposed PD research approach of Hill et al. (2013), because one of the goals is to analyse the feasibility of the PD programme design. All participating teachers had access to a digital learning environment (DLE, which is described in more detail in section 2.2.2) with log file data output based on students' performance, but the data visualisations and additional PD training varied across conditions (ter Beek et al., 2018). We split the intervention into two phases to be able to analyse differences between and within conditions.

2.2.1. Research conditions. Four secondary schools participated in this intervention. Randomisation was carried out at the school level to ensure that all teachers within a school would be treated equally and to avoid contamination of the results among colleagues. This resulted in a quasi-experimental design with four teachers in Experimental group A, two teachers in Experimental group B, and three teachers in the control group (see Figure 2). We carried out the research in two consecutive phases, in which access to student data and the available support for teachers varied between conditions (see section 2.2.3 and 2.2.4). We conducted classroom observations during each phase and teacher questionnaires after each phase; these are referred to as T1 and T2 (see section 2.3).

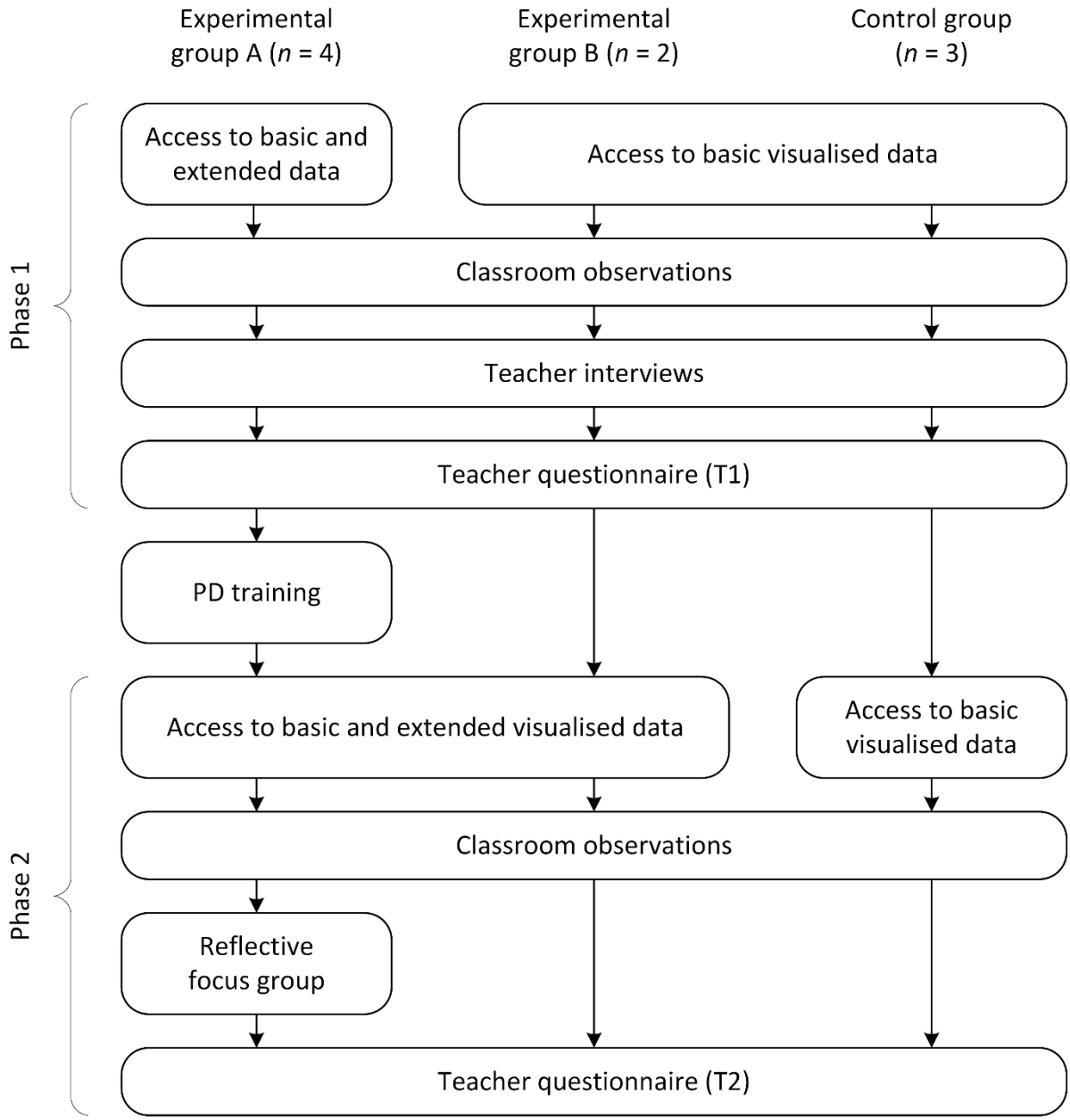

Figure 2. Research design and procedure for this study.

2.2.2. Data visualisations in the digital learning environment (DLE). Students from all history teachers' classrooms worked in a DLE in which students weekly read expository history texts about Greeks and Romans and subsequently answered ten multiple-choice questions about the text. All texts and questions were created by the researchers in cooperation with the participating teachers. Both Phases 1 and 2 consisted of six consecutive lessons. During lessons 2 to 5, students could consult supportive hints with cognitive and

metacognitive strategy instruction in the DLE while reading the text and answering the questions. Cognitive hints focused on the content of the text (e.g., "A causal relation can be found in paragraph two: try to look for words like *because* or *therefore*"), while metacognitive hints aimed at students' regulation of their reading process (e.g., "Try to scan the text before reading to get an impression of what the text will be about"). After each multiple-choice question, students were asked to indicate their confidence in the correctness of their answer (i.e., judgement of learning) on a scale from 1 (*really unsure*) to 5 (*really sure*).

The DLE automatically translated log file data regarding students' performance, use of hints, time spent in the DLE, and judgement of learning into visualised data output for teachers. Furthermore, it presented individual and average classroom scores on various historical skills, such as recognising causal relationships or the chronological order of events, based on the students' performance on the multiple-choice questions. Lastly, the programme automatically assigned students to one of six possible profiles based on students' overall performance, hint use, and judgement of learning. Examples of these profiles are 'comprehensive readers' (i.e., students who have high reading comprehension scores and correctly judge their own learning), or 'inconsistent readers' (i.e., students who have low comprehension scores, but have correct judgements, and use supportive hints – they are 'inconsistent' because one would not expect these students to have low performance scores). These extended, detailed data can help teachers to not only determine student differences and difficulties, but also the possible causes of it.

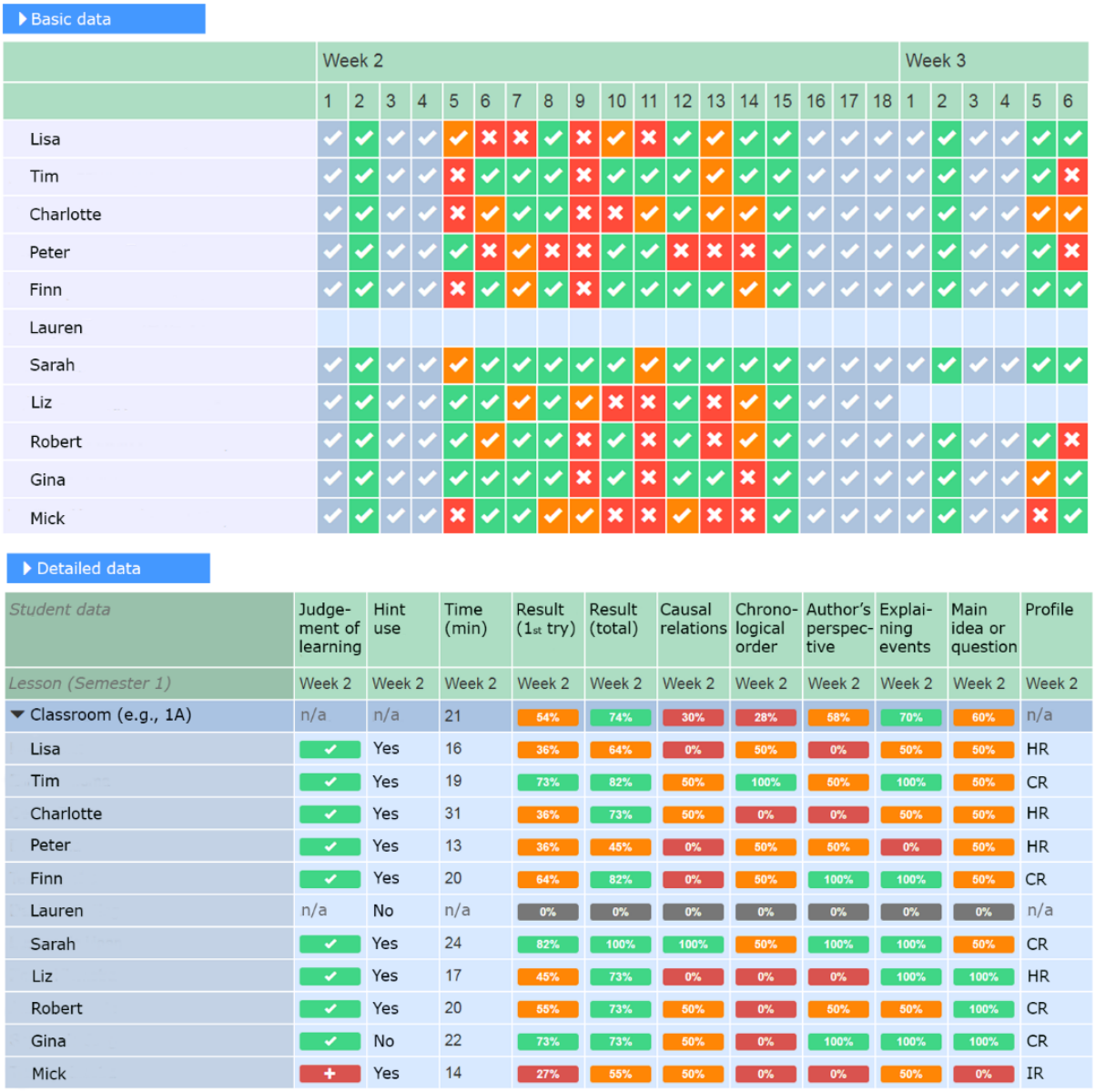

Figure 3. Examples for the basic visualised data (top) and extended, detailed visualised data (bottom). All student names are pseudonyms. HR = Help-seeking Reader; CR = Comprehensive Reader; IR = Inconsistent Reader.

Figure 3 shows the different data visualisations from the DLE. For the basic visualised data (top), green check marks indicate that a students' answer was correct on the first try; orange check marks represent a corrected answer at the second try. A red cross indicates an erroneous answer at both first and second try. Grey squares with check marks resemble open-ended questions that were not automatically scored by the DLE. For the extended visualised

data (bottom), a green check mark indicates correct estimation of performance; a red plus sign indicates overestimation, whereas a red minus sign indicates underestimation. Hint use is indicated with ‘yes’ (i.e., one or more hints used) or ‘no’. Time spent in the DLE is shown in minutes per lesson. All performance scores between 1–33% are red; those between 34–66% are orange, and 67–100% are green. A grey score of 0% indicates that a student did not start the lesson yet.

2.2.3. Phase 1. During Phase 1, all teachers were provided with basic progress data, indicating whether students finished a lesson and whether their multiple-choice answers were correct or incorrect. Additionally, teachers in Experimental group A were provided with extended data visualisations about students’ judgement of their own learning, time spent on task, use of supportive hints, and performance across various historical skills, such as recognising causal relationships or the chronological order of events. However, they did not receive any guidance or training to use or interpret the extended data during Phase 1.

2.2.4. Phase 2. Prior to Phase 2, the teachers from Experimental group A were provided with the same extended data visualisations as in Phase 1, in addition to the basic progress data. Additionally, they received a PD training with a guiding manual with instructions on how to implement explicit reading strategy instruction based on the provided visualised student data. The teachers in Experimental group B also received extended data visualisations in addition to the basic progress data during Phase 2, but no PD training. For teachers in the control group, the conditions were similar to Phase 1; they only received basic progress data.

2.2.5. The PD training and accompanying manual. To limit workload for the participating teachers in the context of high work pressure (Vanhoof et al., 2013), we carried out a short and single PD training at the school of Experimental group A. This 2-hour training covered several principles similar to reciprocal teaching (Palincsar & Brown, 1984), such as

teaching comprehension-fostering reading strategies and expert modelling, and principles from structured or direct instruction (cf. de Jager et al., 2002), such as presentation of new content, guided and individual practice, and summarisation of content and evaluation. Additionally, the PD training covered both the use and the interpretation of the detailed visualised student data (Staman et al., 2014), as well as how teachers might integrate reading strategy use during their classroom instruction.

We supplemented the training with six 1-hour preparatory activities that teachers could complete individually in their own time. Inspired by the PD studies conducted by Ritzema (2015) and Van Kuijk et al. (2016), we constructed a guiding manual that involved three effective PD components: setting goals, acquiring relevant instructional skills in reading comprehension, and applying data use. These components were integrated in six guided lesson formats. For each of the six lesson formats, the first element in the manual is an informative text about the benefits and the use of two specific reading strategies (see Table 2). Secondly, three guiding questions help the teachers prepare their lesson by paying explicit attention to these strategies and by making use of the visualised data, for example to differentiate instruction for students who performed below average. Lastly, four reflective questions help the teacher to reflect on his or her lesson afterwards and to set new goals for lessons to come. At the end of the intervention, teachers had to evaluate the usefulness of the PD training and the accompanying manual using an evaluation form on the last page.

2.3. Procedure

With regard to the data collection procedure, this study has a mixed-method convergent parallel design (Dingyloudi & Strijbos, 2018). We collected all data sources separately but parallel; this enabled us to explore or confirm quantitative findings from the teacher questionnaires and classroom observations with qualitative, in-depth interview data.

Table 2

Lessons, Strategies, and Visualised Student Data Incorporated in the PD Guiding Manual

Lesson	Central strategies to address by the teacher	Visualised student data to consult by the teacher
1	Motivating and Orienting	Previous comprehension performance in Lessons 1 to 6, Phase 1
2	Planning and Expecting	Time spent on Lesson 1, Phase 2
3	Structuring and Diagnosing	Summaries written in Lesson 1, Phase 2
4	Adjusting and Help Seeking	Hint use in Lessons 2 and 3, Phase 2
5	Evaluating and Reflecting	Tips formulated in Lessons 3 and 4, Phase 2
6	Subject-specific and Cross-subject strategies	Comprehension performance (per category) in Lessons 2 to 5, Phase 2

2.3.1. Classroom observations. During Phases 1 and 2, we conducted classroom observations to assess teachers' instructional behaviour and their variety in strategies used. We observed both regular and intervention lessons in weeks 2–5 to determine whether the training influenced teachers' general instructional behaviour. Since researchers or research assistants carried out all classroom observations individually, we recorded teachers' instruction using an audio recorder to be able to check the on-site coding afterwards. Six teachers gave consent to audio recordings of their lessons; three teachers (all in Experimental group A) only gave permission to observe the lesson without using a voice recorder. We observed at least two lessons in each classroom, resulting in 44 observations during Phase 1 and 40 during Phase 2. All observations comprised lessons of 50 minutes.

2.3.2. Teacher interviews. All participating teachers were willing to participate in an interview after Phase 1, and gave consent to record the interview with an audio recorder. The interviews were scheduled after students completed the last lesson in the DLE. We used a semi-structured interview format to ensure the uniformity of questions posed to every teacher,

while at the same time allowing for flexibility with regard to teachers' remarks about the intervention. Each interview lasted approximately one hour.

2.3.3. Teacher questionnaire. We administered a self-report questionnaire (detailed in section 2.4.2) about the teachers' knowledge, attitudes, and self-efficacy beliefs towards reading strategy instruction (i.e., T1). We presented this questionnaire to the participants after we conducted the interviews, to avoid influencing the interview results. The same questionnaire was administered after the reflective focus group meeting at the end of Phase 2 (i.e., T2).

2.3.4. PD training and reflective focus group meeting. Experimental group A received a 2-hour PD training prior to Phase 2. During this training, the teachers received a guiding manual to support their lesson preparation based on student data for all lessons in Phase 2. The PD training was not recorded. After Phase 2, all four teachers met in a reflective focus group setting, where we discussed the teachers' personal experiences with the PD training and the guiding manual. Similar to the interviews, we recorded this focus group meeting using an audio recorder.

2.4. Instruments

2.4.1. Observation instrument. Previous research on teachers' instruction of reading strategies in the classroom provided various reliable methods to observe classroom instruction (Dignath-van Ewijk et al., 2013; Linthorst & de Glopper, 2015; Smale-Jacobse, 2013; Smale-Jacobse & Timmerman, 2015). Because we used a digital programme specifically designed for this project, and to ensure ecological validity of our measurements, we composed a new observation instrument using elements from the aforementioned studies.

The observation instrument consisted of two parts. Part A assessed teachers' reading strategy instruction by focusing on the occurrence of 25 specific reading strategies, whose categorization (e.g., orienting, structuring, evaluating) was based on the effective learning

strategies found in the meta-analysis of Donker et al. (2014). The individual items within these categories were based on the observed reading strategies in the studies by Linthorst and De Glopper (2015), Smale-Jacobse (2013), and Smale-Jacobse and Timmerman (2015). Strategy instruction could occur before reading a text (e.g., *Paying attention to specific elements of the text, such as illustrations or subheadings*), during text reading (e.g., *Monitoring text comprehension while reading*), or after reading (e.g., *Evaluating one's feelings or opinions about the text*).

The occurrence of reading strategies was to be scored categorically (i.e., did it occur, and if so, how?) instead of numerically (i.e., how many times a reading strategy occurred during the lesson). If a strategy occurred during the observed lesson, the observant had to indicate the mode in which it occurred: teacher explanation (E), questioning students (Q), or modelling the strategy (M). Moreover, explanations or questions could be specified as implicit (im) or explicit (ex) instruction (see Figure 4). Similar to the ATES instrument used by Dignath-van Ewijk et al. (2013), "implicit strategy instruction was coded every time teachers prompted the students for strategic behavior without addressing the strategic aspects of the behavior" (p. 343). Thus, implicit instruction does not focus specifically on the *how* or *why* of a certain strategy, but mentions it indirectly (e.g., *"Think of what you already know"*).

In contrast to implicit instruction, explicit instruction includes step-by-step explanations of applying a strategy or elaborations on the usefulness of a certain strategy (e.g., *"Activation of prior knowledge before reading a text is a useful strategy for comprehensive reading, because it makes it easier for the brain to absorb new information"*). Whenever teachers elaborated on or questioned students about the usefulness or the specific application of a particular strategy, we coded this as explicit instruction. For example, *"What do you do when you don't know the definition of a difficult word?"* is coded as explicit instruction by questioning students, whereas *"What does this word mean?"* is coded as implicit instruction.

Due to the exceptionality of modelling behaviour, we conceptualised this as a separate mode of instruction and made no distinction between implicit and explicit instruction. Modelling behaviour was coded if a teacher phrased his or her instruction using a first-person view (e.g., *"I think that...", "I find this...",* or *"In my opinion..."*). Lastly, there was room for the observers to write down additional details, such as explanations for their choices made with regard to coding or general remarks about the observed instruction.

	E		Q		M	n/a
Structuring	im	ex	im	ex		
15. Summarising (parts of) the text.	☐	☐	☐	☐	☐	☐
Explanation:						
	im	ex	im	ex		
16. Indicating the main idea(s) of the text.	☐	☐	☐	☐	☐	☐
Explanation:						
	im	ex	im	ex		
17. Retelling in one's own words what the text is about.	☐	☐	☐	☐	☐	☐
Explanation:						

Figure 4. Excerpt from the classroom observation instrument (Part A)[2].

Part B of the observation instrument focused on the use of data output in the classroom. It indicated whether teachers referred to information from the DLE in their lessons (yes/no, e.g., *"I can see which students are lagging behind"*). It also focused on whether teachers paid specific attention to one of the variables in the detailed data visualisation, such as time spent on task or hint use – by mentioning something positive or something negative, by providing extra explanation, or by giving a specific assignment to their students.

2.4.1.1. Testing the observation instrument. The first author and four research assistants jointly trained the use of the observation instrument by coding fictional history lessons prior to the intervention. Unfortunately, there were no audio-visual materials available in which history teachers provided their students with reading strategy instruction. Therefore,

[2] The full instrument (in Dutch) is included in Ter Beek et al., 2018.

to test interrater reliability, the first author drafted fictional utterances of teacher instruction[3]. Every observer had to assign 25 different fictional utterances to one of the 25 items on the observation instrument. After that, all had to indicate the mode of instruction. Since multiple observers coded the lessons and the items on the observation instrument were nominal, we used Krippendorff's alpha to establish reliability (Hayes & Krippendorff, 2007).

Analysis of the training scores yielded a Krippendorff's alpha reliability estimate of 0.92 for the scores on item level combined with the mode of instruction (E, Q, or M), which indicates good agreement between the observers. However, when analysing the scores including a more detailed distinction between implicit or explicit instruction (E_{im}, E_{ex}, Q_{im}, Q_{ex}, or M), the Krippendorff's alpha value was 0.66. Since a value of 0.66 is often considered the lower bound for reliability, the results of the analysis concerning the distinction between implicit and explicit instruction must be interpreted with caution (Hayes & Krippendorff, 2007; Krippendorff, 2004; Strijbos & Stahl, 2007).

2.4.2. Teacher questionnaire. We adapted three existing self-report questionnaires about teachers' knowledge, attitudes, or self-efficacy beliefs towards reading strategy instruction, and rephrased items to suit the context of secondary education. We only selected items that suited our research context, such as items focusing on comprehensive reading, to enhance the ecological validity of the instrument. Our sample size at T1 (n = 8) was too low to obtain good estimations of the reliability of scale scores; however, papers describing the original instruments report Cronbach's alphas ranging from 0.77 to 0.96 (see Table 3). Demographic items in the teacher questionnaire determined characteristics such as gender, age, and years of work experience.

[3] The first author holds a Master's degree in history education; through practical experience, she could properly assess which forms of instruction often occur in classrooms. Therefore, training the coding of the lessons with fictional strategy instruction was the best possible option methodologically.

The first scale, which we fully adopted from the instrument used by Dignath-van Ewijk and Van der Werf (2012), assesses teachers' knowledge on effective strategy instruction, based on the model of effective strategy instruction by Pressley, Harris, and Marks (1992). Teachers had to indicate the importance of certain ways of teaching strategies, each item starting with '*When teaching strategies, it is important to…*'. Eight items were measured on a 5-point Likert scale ranging from 1 (*totally disagree*) to 5 (*totally agree*). The second scale, adapted from Meijer, Verloop, and Beijaard (2001), measures teachers' assumptions about the importance of comprehensive reading skills. We used this scale to indicate teachers' attitudes toward reading strategy instruction; if a teacher values students' comprehensive reading skills, we expect that they acknowledge the importance of reading strategy instruction. The original Importance Scale consists of ten items, equally divided over two segments: (a) the importance of reading comprehension skills for student development and (b) the importance of goal setting in teaching reading comprehension. We only selected the first five items, since these were the most relevant for our study. Items were measured on a 5-point Likert scale ranging from 1 (*totally disagree*) to 5 (*totally agree*).

The third scale, based on the Teachers' Sense of Efficacy for Literacy Instruction Scale by Tschannen-Moran and Johnson (2011), assesses teachers' feelings of self-efficacy towards reading strategy instruction. We reduced the original 22 items to 11, omitting items focusing on instruction about strategies on other areas than comprehensive reading (i.e. writing, oral reading, and collaborative learning). All items started with '*To what extent are you able to…*' and were measured on a 5-point Likert scale ranging from 1 (*not at all*) to 5 (*very capable*).

Table 3

Number of Items, Examples, and Reliability Indicators for the Teacher Questionnaire Scales

Construct	Scale	*N* items	Example	Original instrument	Cronbach's α (original)
Knowledge	Teachers' strategy instruction knowledge	8	*'It is important to explain and model different learning strategies'*	Dignath-van Ewijk & van der Werf (2012)	0.77 (8 items)
Attitude	Importance of reading strategies	5	*'Reading comprehension is important for students' general achievement'*	Meijer, Verloop, & Beijaard (2001)	0.89 (10 items)
Self-efficacy beliefs	Teachers' sense of efficacy for literacy instruction	11	*'To what extent can you implement effective reading strategies in your classroom?'*	Tschannen-Moran & Johnson (2011)	0.96 (22 items)

2.4.3. Teacher interviews and reflective focus group meeting. We used a semi-structured interview format focused on four main topics: (a) questions about the importance of reading comprehension and how teachers provide regular reading instruction; (b) questions about the teachers' impression of their students; (c) questions about the contents of the DLE and the provided visualised data; and (d) a general evaluation of working with the DLE. The topics of the semi-structured interview format complemented the three components of the teacher questionnaire in a qualitative way, in line with the convergent parallel design of this study (Dingyloudi & Strijbos, 2018). During the reflective focus group meeting, similar topics were discussed, albeit in a more open-ended fashion.

2.5. Data Analysis

2.5.1. Quantitative data analysis. We used descriptive statistics using IBM SPSS Statistics 25 to analyse quantitative data from the teacher questionnaires and the classroom observations to answer research questions 1 and 2. Because of the small teacher sample, we analysed the questionnaire data on a descriptive and individual level. Since the teachers in our sample taught lessons to various classrooms and the number of observations varied between classrooms, we calculated the average number of different strategies observed (out of a maximum of 25) per lesson for each classroom. These data were also analysed descriptively to provide an explorative comparison of the observed instruction in Phases 1 and 2.

2.5.2. Qualitative data analysis. We used qualitative data from the teacher interviews and the reflective focus group meeting to answer the third research question. We recorded and transcribed all utterances. Using Atlas.ti 8.3, the first author coded the interview data using emerging categories (Creswell, 2013) and four broad categories embedded in the semi-structured interview format: the importance of reading comprehension, teachers' impression of students, the provision of regular reading instruction, and the use of the visualised data in the DLE. The cross-tabulation option in Atlas.ti enabled us to create conceptually clustered matrices (Miles, Huberman, & Saldaña, 2014), which we used to analyse the different themes that emerged from the interview data. To illustrate our findings, we included verbatim quotations; for the sake of readability, we have removed any hitches or repetitions, provided that no important information was lost by doing so. The numbers following the quotations refer to the document and quotation number in the Atlas.ti dataset.

3. Results

3.1. Teachers' Knowledge, Attitudes, and Beliefs

The following results provide a descriptive overview of how the PD training in data use and reading strategy instruction affected teachers' knowledge, attitudes, and beliefs with

regard to teaching reading strategies. Experimental group A consists of Alex, Barbara, Chris, and David; Experimental group B of Eric and Frank. George, Harry, and Ian belong to the control group (see Table 1). Unfortunately, T2 data are missing for Barbara. In addition, we were unable to make comparisons for George and Ian, since they both completed only one questionnaire (T1 and T2, respectively).

All participating teachers showed high levels of perceived knowledge about effective strategy instruction, with average scores ranging from 3.88 to 4.63 on T1 (see Table 4). After the PD training, the average scores of Alex and Chris decreased, while David's score increased. The average scores of Eric, Frank, and Harry decreased as well. Teachers' attitudes towards the importance of reading comprehension were very positive on T1, ranging from 4.00 to 4.80. Although for most of the teachers this average score remained high at T2, it slightly decreased for Alex and Chris. However, the differences were very small. The average self-efficacy beliefs towards reading strategy instruction on T1 ranged from 3.00 to 4.10. There is a slight increase visible at T2 for Alex, Chris, and David (Experimental group A), but also for Eric (Experimental group B). Frank's self-efficacy beliefs remained stable; Harry's score slightly decreased.

Table 4

Average Scores on Teachers' Knowledge, Attitude, and Self-Efficacy Beliefs Regarding Reading Strategy Instruction at T1 and T2

Teacher	Condition	*M* knowledge		*M* attitude		*M* self-efficacy beliefs	
		T1	T2	T1	T2	T1	T2
Alex	Exp. A	4.50	4.00	4.80	4.60	3.00	3.45
Barbara	Exp. A	3.88	n/a	4.00	n/a	3.50	n/a
Chris	Exp. A	3.88	3.50	4.80	4.40	3.50	3.64
David	Exp. A	4.13	4.50	4.60	4.60	3.00	3.09
Eric	Exp. B	4.13	3.75	4.40	4.40	3.20	3.64
Frank	Exp. B	4.63	3.88	4.80	5.00	3.10	3.09
George	Control	4.25	n/a	4.80	n/a	3.10	n/a
Harry	Control	4.13	4.00	4.00	4.00	4.10	3.91
Ian	Control	n/a	3.50	n/a	5.00	n/a	2.91

Note. All teacher names are pseudonyms. T1 data are missing for Ian; T2 data are missing for Barbara and George.

3.2. Variety in Teachers' Instructional Behaviour

3.2.1. Phase 1. Teachers in all conditions did not differ descriptively in their average amount of various reading strategies used during Phase 1, with the exception of Barbara, who provided no reading strategy instruction at all. The average amount of various strategies used per lesson ranged from 0.00 to 3.25 (see Table 5). Detailed analysis of the observations revealed that strategies enacted in all conditions were mostly orienting strategies *before* reading, such as introducing the subject of the text or paying attention to specific elements of the text. During Phase 1, we never observed expectation or reflection strategies. More than half of the observed types of strategy instruction was implicit; with regard to the mode of instruction, explanation by the teacher was observed most often, followed by questioning students and modelling. Chris, George, and Harry did not model their instruction at all during the observations in Phase 1.

3.2.2. Phase 2. On average, teachers showed a higher variety of reading strategy instruction during Phase 2 compared to Phase 1, with the exception of Frank. The average amount of various strategies used per lesson ranged from 1.00 to 9.00 (see Table 5). There were no clear differences between the three research conditions. In Experimental group A, Alex and Chris showed a sharp increase in the average observed variety of strategies used. Overall, the various observed strategies were mostly orienting strategies, followed by adjustment strategies (e.g., control of text comprehension during reading). In addition, in Phase 2 we also observed motivating and reflecting strategies during classroom observations in Experimental group A, which was not the case for the other conditions. With regard to the mode of strategy instruction, there were no clear differences between Phases 1 and 2. However, Table 5 shows that Alex, Chris, David, and Harry modelled their instruction more often compared to Phase 1.

Table 5

Observed Average Strategy Instruction per Classroom per Lesson in Phase 1 and Phase 2 Specified by Type and Mode

Teacher	Class	Condition	*M* strategies (x/25)		% Explanation (E)		% Questioning (Q)		% Modelling (M)		% Explicit instruction	
			Phase 1	Phase 2	Phase 1	Phase 2	Phase 1	Phase 2	Phase 1	Phase 2	Phase 1	Phase 2
Alex	I	Exp. A	2.00	8.67	63.6	66.7	36.4	39.5	36.4	25.6	0.0	7.7
	II	Exp. A	2.00	7.00	60.0	65.1	22.2	22.5	10.0	34.9	20.0	0.0
Barbara	III	Exp. A	0.00	4.00	n/a	50.0	n/a	14.3	n/a	42.9	n/a	7.1
	IV	Exp. A	0.00	2.00	n/a	62.5	n/a	0.0	n/a	37.5	n/a	0.0
	V	Exp. A	0.00	2.00	n/a	66.7	n/a	0.0	n/a	33.3	n/a	0.0
Chris	VI	Exp. A	1.75	4.67	100.0	68.2	22.2	27.3	0.0	27.3	0.0	4.6
	VII	Exp. A	1.00	9.00	80.0	63.6	0.0	18.2	20.0	31.8	0.0	4.6
David	VIII	Exp. A	2.50	4.00	43.8	55.6	14.3	20.0	50.0	27.8	6.2	16.7
Eric	IX	Exp. B	3.25	6.75	63.2	64.3	10.5	10.3	31.6	35.7	5.3	0.0
	X	Exp. B	1.75	3.25	66.7	66.7	22.2	29.2	22.2	29.2	11.1	4.2
Frank	XI	Exp. B	2.50	1.00	61.5	60.0	16.7	0.0	30.8	40.0	7.7	0.0
George	XII	Control	3.00	n/a	70.0	n/a	0.0	n/a	30.0	n/a	0.0	n/a
Ian	XII	Control	n/a	1.67	n/a	71.4	n/a	0.0	n/a	28.6	n/a	0.0
Harry	XIII	Control	1.50	7.00	50.0	51.4	0.0	11.4	50.0	37.1	0.0	11.4

Note. All teacher names are pseudonyms. George and Ian taught lessons to the same classroom; George during Phase 1, and Ian during Phase 2.

3.2.3. Use of the DLE. With regard to the use of the DLE in the classroom, we found that teachers occasionally discussed performance or progress results based on information provided by the DLE with their students during Phases 1 and 2, albeit mostly individually. Some teachers mentioned to their students at the start of the intervention in Phase 1 that they were able to consult information about students' progress. Additionally, most teachers encouraged their students to use supportive hints or to take their time when working in the DLE, but these comments were often quite general (e.g., *"Don't work too fast"* or *"You can click on hints if you like"*). Teachers in Experimental group A and B seldom referred to the detailed data visualisations. Harry's use of the DLE was exceptional; he used basic data from the DLE to grade his students, even though we explicitly demanded not to use the data for grading purposes[4]. Apart from that, there were no visible differences regarding the use of the DLE between teachers in different conditions in both Phases 1 and 2.

3.3. Teacher Experiences

Several themes concerning teachers' experiences with using the DLE in the classroom and consulting the visualised student data emerged during the coding of the interview data. Furthermore, during the focus groups, we also discussed the experiences with the PD training and the guided manual with teachers from Experimental group A (i.e., Alex, Barbara, Chris, and David), which led to the identification of practical and contextual barriers for implementation. This section describes the main findings, using quotes from the interviewed teachers to clarify and support them.

3.3.1. Importance of reading comprehension. Barbara, Chris, David, and Frank explicitly acknowledged the importance of reading comprehension for the subject of history, calling it "crucial" (Barbara, 4:66) and "part of my subject" (Chris, 5:62). Alex and Eric both

[4] A research assistant discovered the use of student data for grading during one of the classroom observations. During the interview, Harry argued that he needed to do so "because otherwise, I cannot assess the ancient Greeks at all" (8:12) and because his students "are motivated by grades" (8:13).

mentioned the importance of identifying main ideas: “to grasp the storyline … and what is more and less important” (Alex, 3:45). Chris, David, and George focused in their interview on the importance of recognising causal relationships in a text, because “history tries to put the mush of the past in a logical order” (Chris, 5:57). Although most teachers were positive about this subject, George was the only one to explicitly state something negative about providing disciplinary literacy instruction: “For me, answering questions at the level of reading comprehension is not the same as [history] education. I struggle with that” (7:12).

3.3.2. Teachers’ impression of students. During the interviews, all teachers expressed concerns about students’ reading and concentration levels. Students’ reading levels vary within classrooms and teachers tend to focus most on the students that have difficulties with reading comprehension. However, for Chris, his general impression of students’ reading levels was low:

> “What they run into, not only in seventh grade, but also in eleventh grade, is that one does not know what is actually behind all the words, that you, as it were, continue to swim on the surface, whilst the essence of a text lies at a depth of three meters.” – Chris, 5:52

This was also the case for David, who mentioned that the reading levels of his students were “poor, I think. Yes, poor.” (David, 6:28). It is important to note here that Chris and David taught lessons to prevocational students, who, on average, have lower comprehension performance scores. For students in pre-university education, teachers more often considered motivation problematic. For example, Eric was concerned about his students’ motivation to work in the DLE: “The motivation for history is now associated with sitting down and reading texts for long periods of time – boring and much of the same” (Eric, 1:48). In addition, David, George, and Harry made remarks about the fact that their students are highly motivated by

grades: “They like that reward structure” (Harry, 8:35). They were concerned that students’ motivation to work in the DLE was low when they did not receive a grade afterwards.

3.3.3. Regular reading instruction. We encountered little reading strategy instruction during the classroom observations. Some teachers acknowledged that they did not provide extensive reading instruction during their lessons: “It is reading, and that is nice and all, but I really prefer telling stories” (Harry, 8:20). Even when teachers were aware of their students’ reading problems, there was a preference for regular content instruction, as stated by Frank:

> “Yea, they just like it when I tell them something about history. When it is very teacher-driven. And we have received test results, and well… they just have problems with texts, with reading. They have the vocabulary of a cucumber.” – Frank, 2:33

Alex, Barbara, Eric, and George noted that they sometimes embed strategy instruction in their history lessons, but this instruction is mostly focused on how to study instead of how to read. Alex also emphasised the fact that his students have different preferences, so they have to “decide for themselves which method suits them; for one, it is questioning the text, for the other, it is better to make a mind map, … and another student does not understand anything at all” (3:49).

3.3.4. Teachers’ use of the DLE. When we asked teachers whether they consulted the visualised student data, most of them mentioned using only the basic information (i.e., whether students finished a lesson or not and the correctness of their answers), even the teachers who had access to detailed data as well. For example, Eric mentioned that he “looked at who was on schedule, but not if the answers were correct – that is probably more relevant for you [researchers]” (Eric, 1:27). Teachers in Experimental group A did not often mention the detailed data visualisations, except for David:

> “I found it very interesting to see it for the first time, and that the results are built up. And the fact that a student ends up in a certain profile at a given time, which can

> change, and once that happens, you can do things with that. I really liked that." – David, 6:4

Barbara noted during the focus group meeting that the basic progress data supported her differentiation practices because the data visualisations in the DLE confirmed the image she already had of her students. David also mentioned that he looked at the data, but found it "a bit too premature" to adapt his instruction (David, 6:20). In contrast, Chris never consulted any type of data in the DLE during the intervention: "I was overwhelmed by this period … I just was not able to do it" (Chris, 9:18). This finding illustrates the discrepancy between the execution of the research project as planned by the researcher versus the actual execution by the participating teacher. Because of workload issues and time constraints, Chris decided not to use the data visualisations, despite the fact that teachers in this experimental condition were stimulated to do so through the PD training and the accompanying manual.

The guiding manual provided teachers with preparatory questions for which they had to consult the detailed data visualisations in the DLE. However, we were not able to analyse the actual use of the guiding manual. Because three teachers in Experimental group A did not return their manuals to the researchers as requested, it remains unclear if and to what extent teachers completed the assignments. David did return his manual, but only filled in Lessons 1 and 2 due to workload issues. For the third lesson, he only wrote, "I have no time to do this. Unfortunately." In fact, teachers in all conditions mentioned workload issues and other practical and contextual barriers, which we therefore decided to analyse and report separately.

3.3.5. Practical and contextual barriers. During the intervention, we noticed that not all teachers implemented the project lessons as planned. Through analysis of the interview and focus group data, it became clear that the intervention suffered from various individual and contextual problems. These factors did not only influence the outcomes of this study, but also probably play an important role in practice-oriented research in general. Insight into

practical and contextual barriers is essential for designing and conducting research interventions in the field of PD training in education; therefore, we have enlisted them below.

3.3.5.1. False notion of the research project. The interview data indicated that three teachers in Experimental group A had a false notion of the independence of the DLE with regard to the regular curriculum and that they were afraid to interfere with the goals of the research project. For example, we did not observe any strategy instruction utterances in Barbara's lessons. During the interview, she stated:

> "I was under the impression that the research question concerned how [students] could independently learn to apply certain strategies within a self-contained environment. So, I have very deliberately disconnected my own lessons and just put them behind the computer. Everything they needed was in the environment." – Barbara, 4:1

Alex probably had the same impression, since he stated that "The idea of [the DLE] was not to, no interference; you just put them to work. You do not comment on anything" (Alex, 3:9). In addition, David remarked that he felt insecure because of the research aspect:

> "I did not trust myself in some things. There is this research project, so a lot is at stake. You need to behave precisely, or else… Whether I did the right things; that was a little painful." – David, 6:10

After the interview, we explained to these teachers that they were allowed to provide any form of instruction, but these false notions probably hampered their instructional behaviour during Phase 1. After Phase 2, Barbara and Alex mentioned that they integrated the contents of the DLE in their lessons more often. For example, Alex started each lesson with instruction about a certain reading strategy, such as orienting and summarising: "I have incorporated the lessons from [the DLE] in my own lessons. I have my own message, that I want to make clear, and I have connected that with the stories in [the DLE]" (Alex, 9:10).

3.3.5.2. Integration with the regular curriculum. Although we discussed the content and the order of the DLE texts with the teachers in advance, Alex, Barbara, Chris, and Harry complained that the contents of the programme did not fully align with the subjects being taught in the regular history lessons. In the Dutch seventh-grade history curriculum, regular methods consist of demarcated periods (e.g., 'the Time of Greeks and Romans'), and teachers can decide for themselves when they start a new period. Therefore, the teachers in this study differed in the subject they were working on with their students during Phases 1 and 2, despite the fact that we asked them to focus on the subject of Greeks and Romans during Phases 1 and 2.

> "For example, we were still working on hunter-gatherers, you know, in prevocational education. We have just started with Egypt and the pharaohs, and then they get a text about barbarians, and trade in ancient Greece, and Greek gods, those things. Well, I did not talk about that in class yet." – Chris, 5:23

Additionally, these teachers noticed during the interviews that they did not integrate the contents of the DLE and their regular lesson materials during Phase 1.

3.3.5.3. Time pressure and lesson preparation. Time pressure was often mentioned during the interviews and during the focus group. Alex, Barbara, Chris, and George complained about the density of the six-week lesson structure of the project and difficulties in combining the DLE with their regular curriculum:

> "I find the time pressure very high, so I would prefer not to say 'you have to finish everything within eight weeks', but you have to be able to spread things. So rather, 'you have ten weeks to complete eight lessons', something like that." – Alex, 3:27

The time pressure possibly also led to little preparation of the lessons. Teachers often did not prepare their lessons according to the guiding manual, and mentioned that they did not read

the texts in the DLE beforehand, so they were not fully acquainted with the contents of the programme.

3.3.5.4. Logistic problems and IT facilities. In some classrooms, students worked on individual laptops, according to their school's bring-your-own-device policy. However, Alex, Barbara, Chris, George, Harry, and Ian had to make use of central computer rooms or laptop carts, which had to be reserved beforehand. This led to logistic problems and sometimes a slightly different implementation of the research project; for example, when teachers used the DLE lessons as homework assignments.

> "Well, this was very enlightening, because digitisation is high on the agenda at our school. Twenty-first-century skills. But this project alone already shows that there are still some limitations … we have laptop carts, but there are not enough laptops. There are always a few broken, and well, if you have a slightly larger classroom with 27 students, you already have a problem." - Barbara, 4:18

However, even in the schools where students had to bring their own devices, the teachers encountered problems:

> "Their Chromebooks are often not fully charged. If that is the case, I send them to the school's media library and I hope they will do everything there, and that they will return as soon as they are finished, but I lose sight … sometimes, the laptops from the media library are all lent. I think there are thirty, and a few are broken. So, students are dependent on their Chromebooks" - Eric, 1:23

If teachers encountered logistic problems during their lessons, it was difficult for them to focus their instruction on reading strategies or to use student data from the DLE to adapt their instruction. In some cases, instructional time was lost due to issues concerning the IT facilities. The problems with computers and laptops also caused irritation among some of the teachers, which did not benefit their motivation to work with the student data from the DLE.

4. Conclusions and discussion

This mixed-method study evaluated the extent to which the provision of visualised student data (with or without PD training in data use and reading strategy instruction) affected in-service history teachers' instructional knowledge, attitudes, self-efficacy beliefs, and behaviour using self-report questionnaires and classroom observations. Additionally, the teachers' personal experiences with the intervention were explored using qualitative interviews and a focus group meeting. By triangulating quantitative and qualitative data sources, we were able to explain our findings and highlight factors that might influence the implementation fidelity of practice-oriented, data-driven interventions.

4.1. Findings

In general, the history teachers reported having high levels of perceived strategy instruction knowledge, and they acknowledged the importance of reading comprehension skills. There were no visible differences between or within conditions after the PD training; the high scores on the pretest remained relatively high on the posttest. This finding can be explained by the fact that the scores on the pretest were already very high, possibly creating a ceiling effect (cf. Staman et al., 2014). Perceived knowledge of two teachers in Experimental group A decreased slightly after the training; these teachers might have realised after the training that they did not know as much as they initially thought they did. It is therefore also hard to link changes in teachers' knowledge, beliefs, and attitudes to changes in their instructional behaviour, as proposed in Desimone's (2009) framework. Furthermore, compared to their knowledge and attitudes, teachers' self-efficacy beliefs regarding reading strategy instruction were slightly less positive. This finding is in line with earlier research, which indicates that although teachers value reading instruction, they often believe they do not have sufficient skills (Greenleaf et al., 2001; Hall, 2005). After the intervention, there was still a difference between teachers' attitudes and self-efficacy beliefs, indicating that teachers

consider reading strategy instruction to be important, but do not always appear to consider themselves fully capable to provide this type of instruction.

With regard to the instructional behaviour, teachers who received a PD training and a guiding manual prior to Phase 2 employed a higher variety of reading strategies during their classroom instruction compared to Phase 1. However, it is important to note that two teachers from Experimental group A deliberately did not intervene with the programme during Phase 1, because they feared they would disturb the research project by doing so – a phenomenon known as the experimenter expectancy effect (Rosenthal, 1976). This explains that Barbara, for example, initially provided no reading strategy instruction at all: her false notion of the research project led her to provide *less* instruction during Phase 1, which presumably led to *more* observed strategy use during Phase 2 (i.e., it was not necessarily influenced by the PD training). In addition, teachers in Experimental group B and the control group also improved the variety of the instructional strategies used, making it hard to attribute this finding solely to the PD training. Although we focused on the variety of instructed reading strategies, the relatively low numbers resonate with earlier research on reading instruction in social studies classrooms (Linthorst & de Glopper, 2015; Ness, 2016).

The observed mode of instruction varied between teachers; however, most of the observed reading strategy instruction was provided as teacher explanation, followed by questioning students. Modelling behaviour occurred rarely as an instructional strategy; nevertheless, it is important to note that the teachers in Experimental group A practised modelling more often in Phase 2 compared to Phase 1, and compared to the other teachers (with the exception of Harry). As stated earlier, the results with regard to the type of reading strategy instruction (implicit, explicit) must be interpreted with caution due to the minimal interrater reliability of this aspect of the observation instrument. Nevertheless, we found that the reading strategy instruction provided also varied between teachers, but it was not

influenced by the experimental conditions. For all teachers, the majority of the observed instruction was implicit; they mostly tell students *what* to do, instead of *how* or *why* they should do it.

Although research has shown that professional development in disciplinary literacy or data use is a long-term process that requires continuous commitment and a supportive school culture (cf. Hoogland et al., 2016; Moje, 2008; O'Brien et al., 1995; Timperley, Wilson, Barrar, & Fung, 2007), it is difficult to implement long-lasting interventions. For practical and financial reasons, PD training initiatives to improve teacher effectiveness mostly occur on a small scale, for example locally (e.g., one school) or regionally (e.g., school district). These types of initiatives often result in small effects (Hill et al., 2013). Because of the small teacher sample in this study and the issues regarding implementation of the PD intervention, it was not feasible to calculate effect sizes for the different conditions. Teachers often did not fully or correctly implement the instructional practices from the PD training and the accompanying manual. For example, some teachers did not consult their students' data output before each lesson, while others never provided reflective strategy instruction after their students read a text. These implementation difficulties are similar to findings from previous research on data use and instruction (Dignath & Büttner, 2008; Donker et al., 2014; Kippers et al., 2018; Okkinga, van Steensel, van Gelderen, & Sleegers, 2018; Ritzema, 2015; Staman et al., 2017; Vanhoof et al., 2013; van Kuijk et al., 2016).

The practical and contextual barriers that teachers mentioned during the interviews and the reflective focus group caused implementation difficulties. We discovered that some of the participating teachers were restricted by a false notion of the research project, the integration of the contents of the DLE with the regular curriculum, little preparation of the lessons due to time pressure, and logistic problems such as the unavailability of computers.

Although they cannot be directly linked to the results, it is important to acknowledge these factors in the context of the current study and future PD intervention studies.

Although we accept the fact that the practical and contextual barriers might have been frustrating for teachers to work with, we also noted that teachers did not provide us with practical solutions or strategic actions to address these problems. Similar to studies found in the review by Hall (2005), teachers blamed the curriculum, the textbook materials, or the students' reading motivation for not being able to provide effective strategy instruction. For example, Frank stated that his students "have the vocabulary of a cucumber" (2:33), but did not express any thoughts on how to improve his students' reading skills. It seems that a positive attitude towards reading strategy instruction, as displayed by all teachers in this study, is not enough to establish adequate reading strategy instruction in the history classroom. It is therefore important to continue the research on subject-specific literacy instruction and the factors that stimulate or hamper teachers' implementation of it.

4.2. Limitations

A methodological limitation of this study concerns the way in which we coded the lesson observations. Due to limited resources, lesson observations were done by individual researchers instead of researchers working in pairs. Therefore, we decided to adapt our observation instrument in such a way that the occurrence of reading strategies was to be scored categorically instead of numerically, to lower the risk of missed information during the observations. By doing so, we were unable to tell whether teachers provided *more* or *less* reading strategy instruction overall as well as for strategies specifically, as is often the case in this type of research (Dignath-van Ewijk et al., 2013; Smale-Jacobse, 2013; Smale-Jabobse & Timmerman, 2015). Nevertheless, our results provide valuable insights in teachers' variety of their instructional repertoire before and after a PD training.

Another limitation concerns the involvement of teachers in designing and preparing the research intervention. In our study, educational researchers designed the intervention and the contents of the PD training, while teachers conducted its practical application. Moreover, we discussed with teachers the reading problems they had identified in their classes, but did not test our assumptions about teachers' own PD needs prior to the training. Theories of practitioner research suggest that the validity of educational research increases when teachers are involved in designing and conducting rigorous research (Lai & Schildkamp, 2013; Robinson & Lai, 2006; Vanhoof et al., 2013). When teachers' theories of action and local knowledge are taken into account in the process, a PD intervention is expected to be tailored to the needs of the teacher, increasing its effectiveness. In addition, confusion about the research purpose or incorrect assumptions about researchers' expectations, such as the ones that occurred in the current study, might be prevented.

We observed both regular and intervention lessons to determine whether the provision of visualised data or a PD training influenced teachers' general instructional behaviour. However, we concluded that reading texts occurred sparingly during regular lessons (cf. Ness, 2016), resulting in a low occurrence of instructional behaviour with regard to reading strategies. Yet, this does not imply that the PD training had no effect. For example, in several lessons Barbara let her students work on creating a historical newspaper and mentioned that by doing so, the information from the PD training was less relevant to her regular lessons at that time. Due to the limited number of observed lessons per classroom, and the high variability among the teachers, the results with regard to teachers' instructional behaviour must be interpreted with caution. We need more large-scale research to explore further the effects of PD trainings in reading strategy instruction and data use on teachers' instructional behaviour; hence, our explorative study might provide helpful suggestions.

4.3. Suggestions for Future Research

We identified several practical and contextual barriers that provided us with important suggestions for future practice-oriented research in the context of teaching reading strategies and using data in education. First, although PD research has been conducted in secondary education before, we noted that this educational context is challenging for practical research projects. During the interviews, many teachers mentioned issues concerning workload, time constraints, and other logistic problems (e.g., the availability of IT facilities, or the loss of lessons due to unexpected schedule changes). Combining the regular curriculum with the requirements of the intervention study, such as preparing the lessons based on student data and incorporating reading strategies during the lessons, might have been too complicated to perform in two fifty-minute lessons a week. With regard to the IT facilities, which Livingstone (2012) argues to be crucial for optimising learning with technology, it is important that future research avoids or reduces these contextual barriers as much as possible.

Second, in order to use digital tools effectively for whole-classroom instruction, good classroom management (i.e., applying basic instructional skills) is an important prerequisite (Okkinga, van Steensel, van Gelderen, & Sleegers, 2018; van de Grift, 2014). In our classroom observations, some teachers seemed to be more concerned with classroom management than with providing explicit reading instruction; teachers mainly used the available data visualisations to check whether students were on schedule, instead of using it for differentiation practices. This is in line with earlier research by Duffy (1982), who noted that with regard to reading instruction, "to the extent that interactive decisions are made, they seem to be associated more with management than with instruction" (p. 359). Future practical research on strategy instruction should include context factors like the classroom or individual students, to determine their role in the effectiveness of research interventions.

Lastly, the current study did not address the effects of teachers' altered instruction on students' academic performance, which is the last step in Desimone's (2009) PD framework.

Future research should therefore assess whether and how changes in teachers' instruction can be sustained on the long term. In addition, it is valuable to analyse the effects of teachers' strategy instruction on students' academic performance, self-regulated learning skills, or motivation to learn, to establish a comprehensive view of the effects of targeted PD training in data use. Finally, in line with Hill et al. (2013), we advocate the use of micro-level analysis in the field of PD interventions in education. The results from the present study illustrate the value of using micro-level analysis and including teachers' personal experiences in effectiveness research, which contributes to the development of future, large-scale PD design interventions.

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